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Research Article

STUDIES ON THE MICELLAR PROPERTIES OF ANIONIC SURFACTANT IN THE ABSENCE AND PRESENCE OF SPIRONOLACTONE AT ROOM TEMPERATURE

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A B S T R A C T

Solubilization is a phenomenon of dissolving the solute into solvent to form homogeneous system. Solubilization of drug is one of the important parameter for the discovery of a drug. In the present paper, we studied the solubility enhancement of a poorly soluble drug i.e., spironolactone with sodium dodecyl sulphate (SDS). Also determine the variation in critical micellar concentration (CMC) of SDS in the presence of different weight-volume ratio solution of spironolactone at room temperature by surface tension and conductivity method. From the measurements, various physicochemical and surface properties Critical micellar concentration (CMC), thermodynamic parameters ($\Delta G°_m$, $\Delta H°_m$, $\Delta S°_m$) have been determined. The negative value of $\Delta G°_m$ shows spontaneity of solubilization process.

INTRODUCTION

Surfactants are organic substances which decreases the surface tension of water at low concentration. They absorbed on the surface of water and form a thin monolayer, therefore it is also known as surface active agent. Mostly all the surfactants contain one hydrophilic polar head and one hydrophobic non polar alkyl chain. At a certain concentration the molecules or ions of surfactant aggregate and form a complex unit called micelle. Micelle formation are important in clinical or pharmaceutical applications. Micelle influence reaction kinetics. Substrate binding and solubilisation in the micelle are the main reasons for influencing reaction kinetics. Micellization characteristics of a surfactant are understood by determining the value of its micellization parameters, such as critical micelle concentration (CMC), aggregation number. Spironolactone is a potassium-sparing diuretic drug with brand name- Aldactone. It help to restore a healthy balance of sodium and potassium in body. It is used in the treatment of hypertension, edema, hypokalemia and severe heart failure. The solubility of spironolactone in water is 0.022mg/ml at 25°C.

In the present work, we report the interaction between of SDS and spironolactone in aqueous medium using conductivity meter and Du nouy tensiometer.

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The drug-surfactant interactions was determined on the basis of conductance and surface tension of drug when going from an aqueous to more hydrophobic environment at various concentration of surfactant. Micellar solubilization is a widely used alternative for dissolution of poorly soluble drugs. Thus by knowing the structures and properties of micelles the solubility of poorly soluble drugs can be enhanced.

Experimental

Surfactant and chemicals are purchased from molychem laboratories, Mumbai and these are AR grade. A number of parameters were investigated such as CMC of sodium dodecyl sulphate (SDS) under different temperature were measured. Effect of spironolactone drug on micellar solution of SDS are also investigated. These parameters were measured using simple conductivity and tensiometric technique.

Chemical used

1. Sodium dodecyl sulphate (SDS)
2. Aldatone (spironolactone)

Apparatus

Conductivity meter: Conductivity measurement were performed with digital conductivity meter supplied by systronic direct reading (type 306). The conductivity cell constant was calibrated with KCl (0.001 and 0.01M) solution in appropriate concentration range. The surfactant solution was progressively added with the help of micro pipette taken in a small beaker and the conductance was measured after thorough at temperature equilibrium. The break point in the plot of

specific conductivity versus the total surfactant concentration was taken as the cmc at the mole fraction.

Surface tensiometer: The surface tension of aqueous solution at various concentration of surfactants were measured on the surface tensiometer (Jencon India) using platinum ring detachment method. The value of surface tension was the average of the three separate measurement. The platinum ring was cleaned with distilled water for 20-25 times. The cleanliness of the glassware and plate were tested by checking the surface tension of pure water. All the measurements were taken at room temperature. The vertically hung ring was dipped into the liquid to measure its surface tension.

Preparation of solutions*:* A stock solution of SDS 0.01M is prepared using double distilled water by direct weighing the chemical in digital electronic balance. From this stock solution a number of solution with desired concentration were prepared. The working solution of drug (0.005%, 0.01%, and 0.05%) was prepared by 1% w/v solution. The effect of spironolactone drug was found that can be explained through tables and graphs.

Variation of CMC value with increasing temperature

The CMC value is obtained at different temperatures using a digital direct reading conductivity meter. The variation of CMC value of sodium dodecyl sulphate (SDS) with the increasing temperature was found and analyzed for finding suitable temperature required for micellization.

RESULT AND DISCUSSION

Thedetermination of CMC of SDS was carried out by conductometry and tensiometry method.

Conductivity method: - The CMC value was measured by plotting a graph between specific conductivity with concentration of SDSat various temperature ranging from 25°C- 45°C. Fig. I shows the variation of CMC of SDS with increasing temperatures. To study the effect of spironolactone on CMC of SDS, solutions of spironolactone were prepared in different weight volume ratio (w/v %) i.e., 0.005, 0.01 and 0.05%. This method is based on the finding of a breaking point on the curve, which describes the concentration based conductivity. It was observed that the CMC value of SDS increases with the increase in temperature shown in table 1. The increases in the CMC value with temperature indicates that the increase in temperature does not favors the formation of micelle. It was also found that the addition of furosemide decreases the CMC value with increasing the concentration of drug. Thus the oral absorption of hydrophobic drugs can be significantly improved by using this micellar system at low temperature.

Table 1 Variation of CMC of SDS with the increasing temperature

S. No.	Temperature (K)	CMC (mM)
1	303	8.9
2	308	10
3	313	11.3

Table 2 Variation of CMC of SDS with increasing concentration of spironolactone at different temperature

Spironolactone solution (W/v %)	CMC of SDS (mM)		
	303K	308K	313K
0	8.9	10	11.3
0.005	3.1	4.9	5.3
0.01	2.6	4.4	4.9
0.05	2.3	3.1	4.2

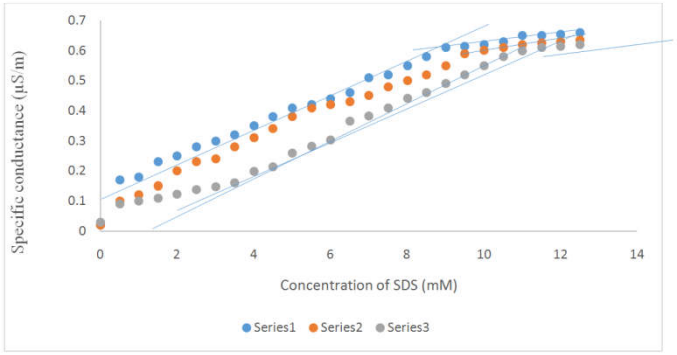

Fig 1 Conductivity as the function of concentration of SDS at different temperatures.

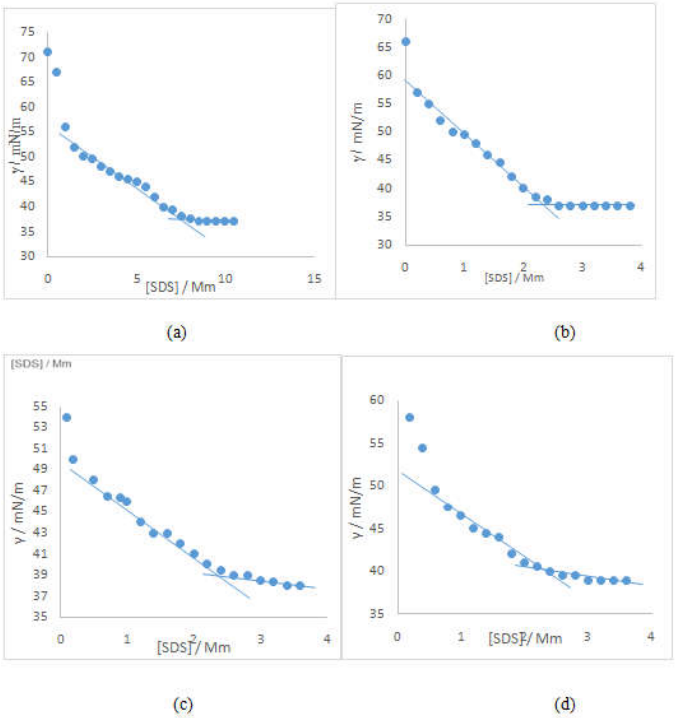

Fig 2 Surface tension verses concentration of SDS at various concentration of spironolactone (a) zero (b) 0.005 % (c) 0.01 % and (d) 0.05 % at room temperature.

Tensiometric method:-A linear decrease in surface tension was observed with increase in SDS concentration up to CMC. The CMC of the surfactant decreased in the presence of drug, the decrease being depended upon the concentration of spironolactone. When an increasing amount of the surfactant is

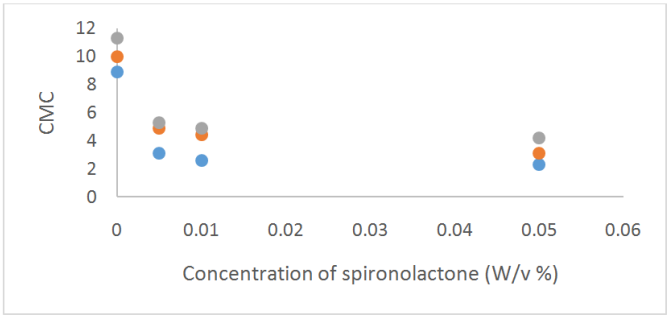

Fig 3 Variation of CMC of CTAB with increasing concentration of furosemide at different temperature

CONCLUSION

Anincrease in the CMC value of SDS with the increase in temperature suggests that a high temperature retards micellar growth i.e. high temperature does not favors micellization

process. Presence of spironolactone in aqueous solutions of SDS results in a decrease in CMC of these surfactants indicating a good solubility of spironolactone in such micellar system. By knowing the suitable values of these parameters, and maintaining these value throughout the experiment, the solubility of poorly soluble drugs in solvent can be enhanced.

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